GLOBAL CCS INSTITUTE

# Importance of CCS and Global Status

**Carbon Capture and Storage – Deep Dive Workshop**

Asian Development Bank

6 June 2016

# Presentation Overview

**Why is CCS important?**

**The contribution of CCS to reduce global emissions**

**Cost of mitigation without CCS**

**Global Status of CCS**

**Summary**

# Why is CCS important?

# Why is CCS important?

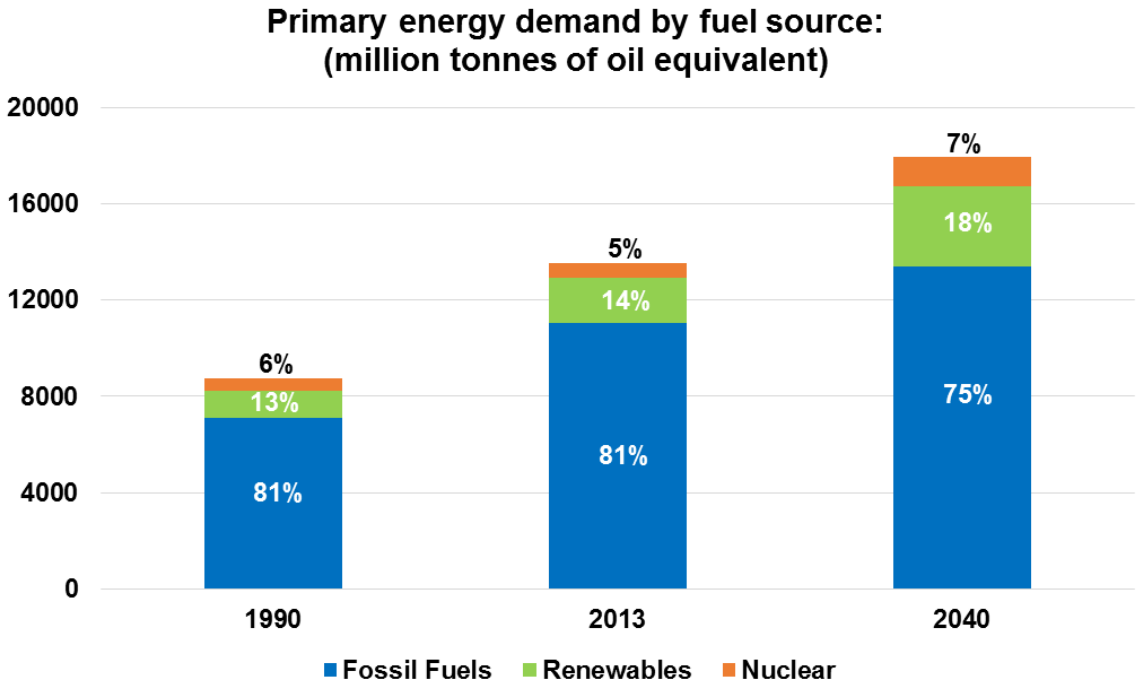
**80%** 80% of the world's energy comes from fossil fuels

**40%** The power sector accounts for about 40% of global $CO_2$ emissions

**25%** 25% of global $CO_2$ emissions come from large-scale industrial processes

**CCS is the only technology that can reduce emissions directly from fossil fuel facilities on a significant scale**

# Fossil fuel use by volume is expected to increase




**Source**: *IEA World Energy Outlook*, 2015 (New policies scenario)

**Fossil fuel proved reserves:**

***6 trillion barrels of oil equivalent***

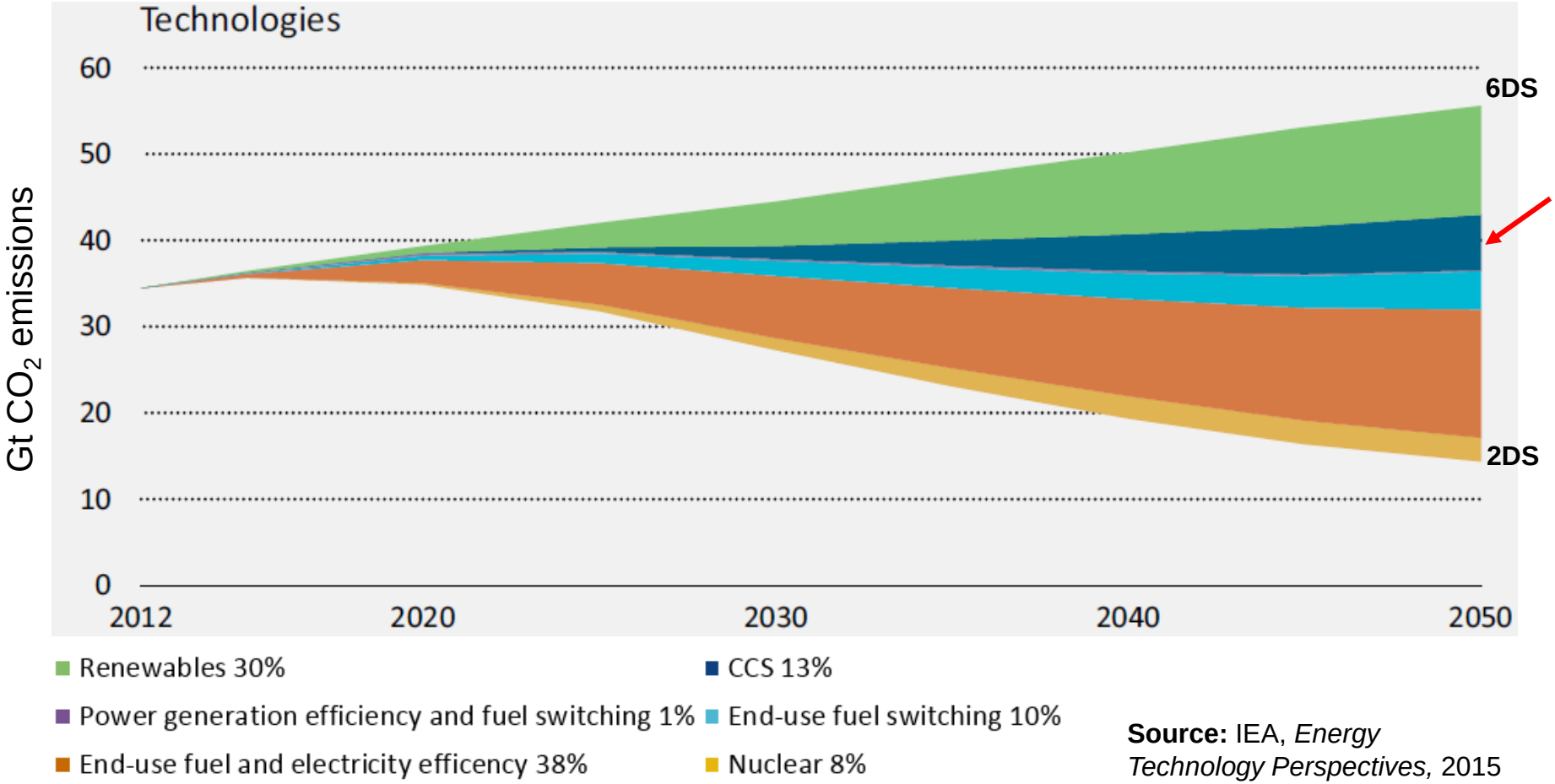
**Reserves to production ratio:**

***~75 years***

**Source**: *BP Statistical Review of World Energy* 2015

# The contribution of CCS to reduce global emissions

# The contribution of CCS to reduce global emissions

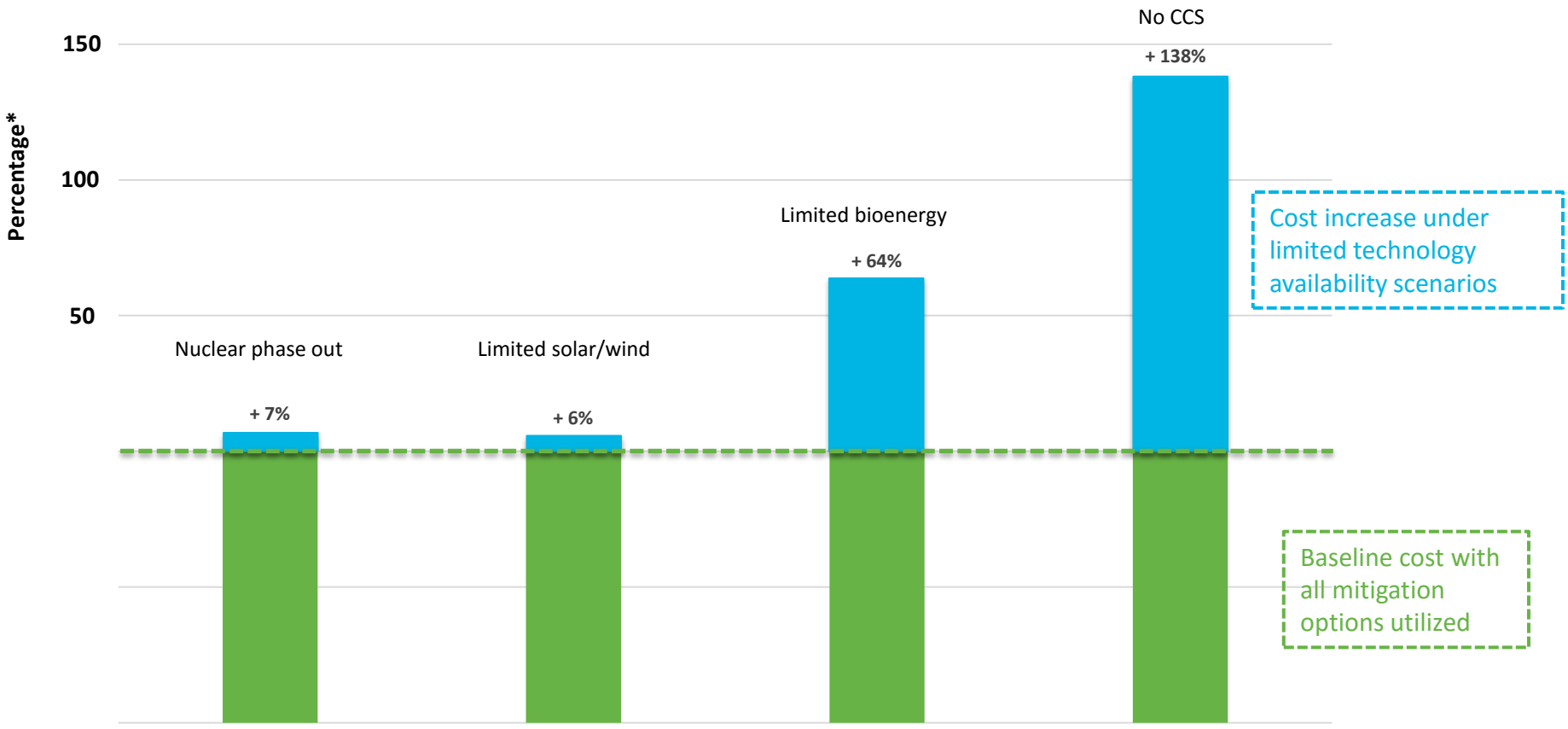



**Source:** IEA, *Energy Technology Perspectives,* 2015

CCS will need to account for 13% of global emissions reductions on a least-cost basis

# Cost of mitigation increases without CCS – by an estimated 138%

# **Mitigation costs** more than double **in scenarios with** limited availability of CCS




*Percentage increase in total discounted mitigation costs (2015-2100) relative to default technology assumptions – median estimate

**Source**: *IPCC Fifth Assessment Synthesis Report, Summary for Policymakers, November 2014.*

# Global Status of CCS – a proven technology at large scale

# Large-scale CCS projects by region or country

| | Early planning | Advanced planning | Construction | Operation | Total |
|---|---|---|---|---|---|
| North America | 1 | 1 | 5 | 10 | 17 |
| China | 4 | 4 | - | - | 8 |
| Europe | 3 | 1 | - | 2 | 6 |
| Gulf Cooperation Council | - | - | 1 | 1 | 2 |
| Rest of World* | 4 | - | 1 | 2 | 7 |
| Total | 12 | 6 | 7 | 15 | 40 |

** Includes projects in Algeria, Australia, Brazil and Korea.*

**North America dominates projects in operation and under construction, China has the most projects in planning**

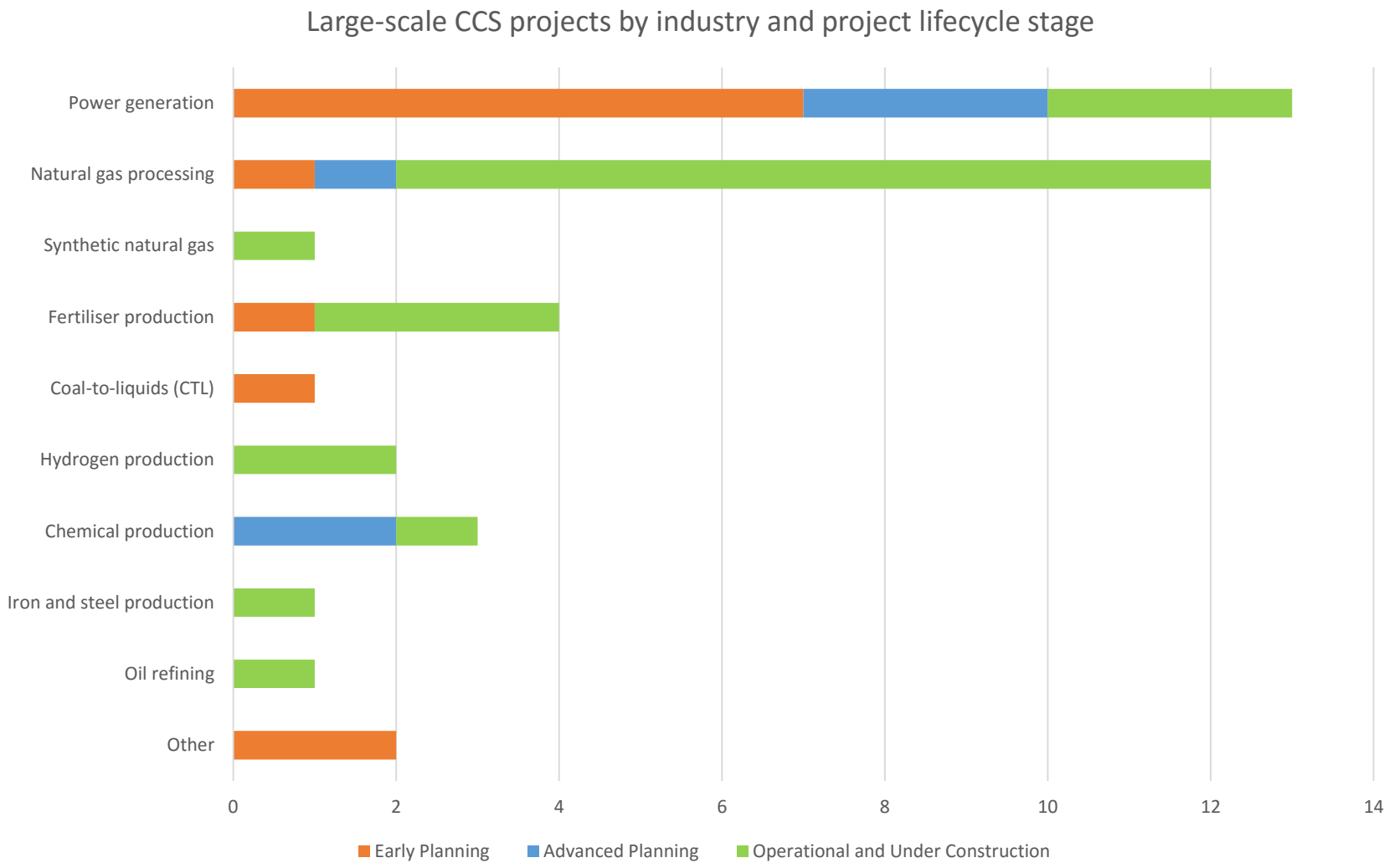
# 15 large-scale projects are operational


**Source**: *Large Scale CCS Projects* database, Global CCS Institute (2015) * Injection currently suspended

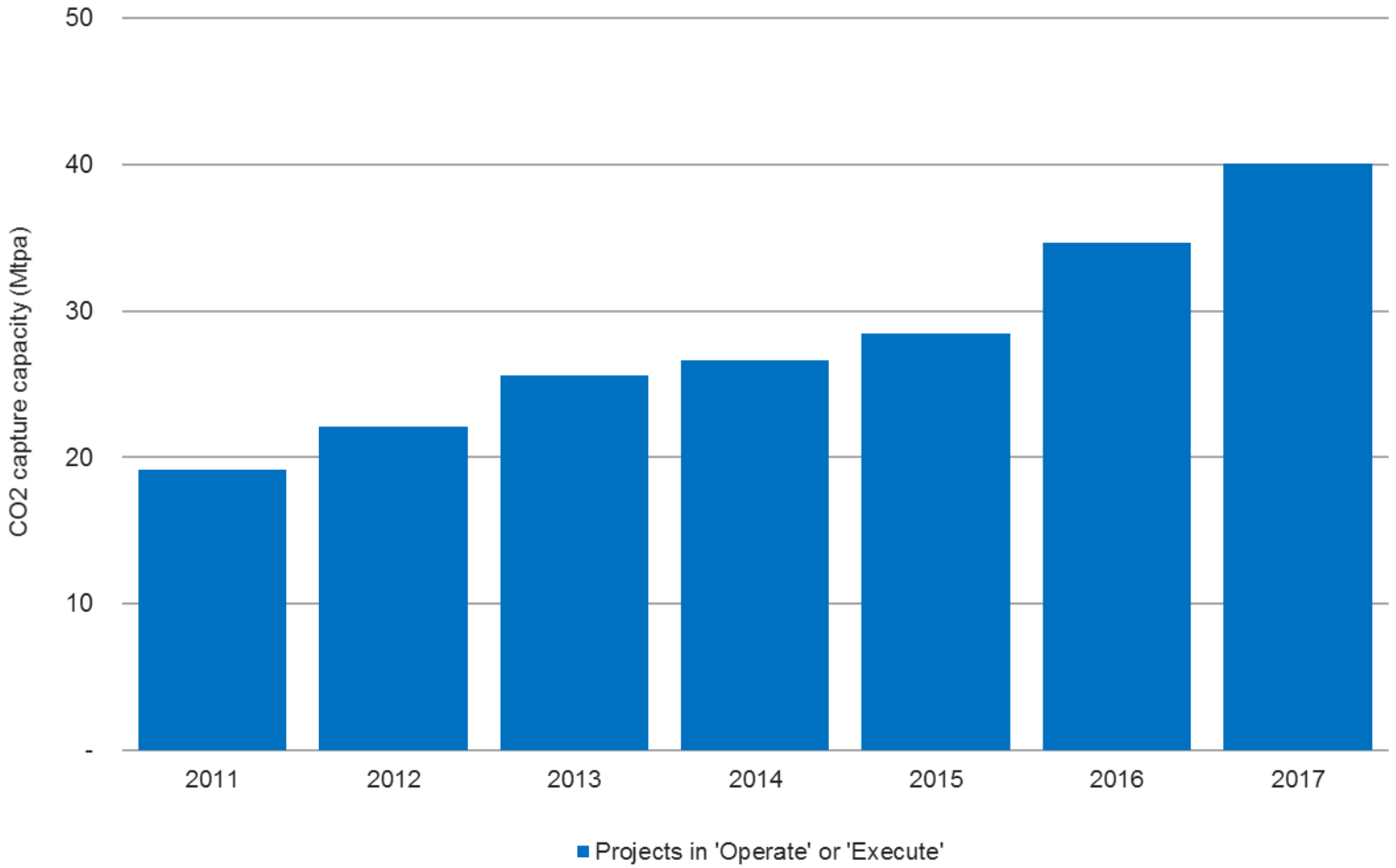
# Large-scale projects expected to become operational by 2017


**Source**: *Global Status of CCS: 2015,* Global CCS Institute (2015)

# Large-scale CCS projects by industry and lifecycle



# CCS is a proven technology




(injection currently suspended for In Salah $CO_2$ Storage Project)

**CCS is already contributing to $CO_2$ abatement**

# Notable pilot and demonstration projects globally

**Canada**

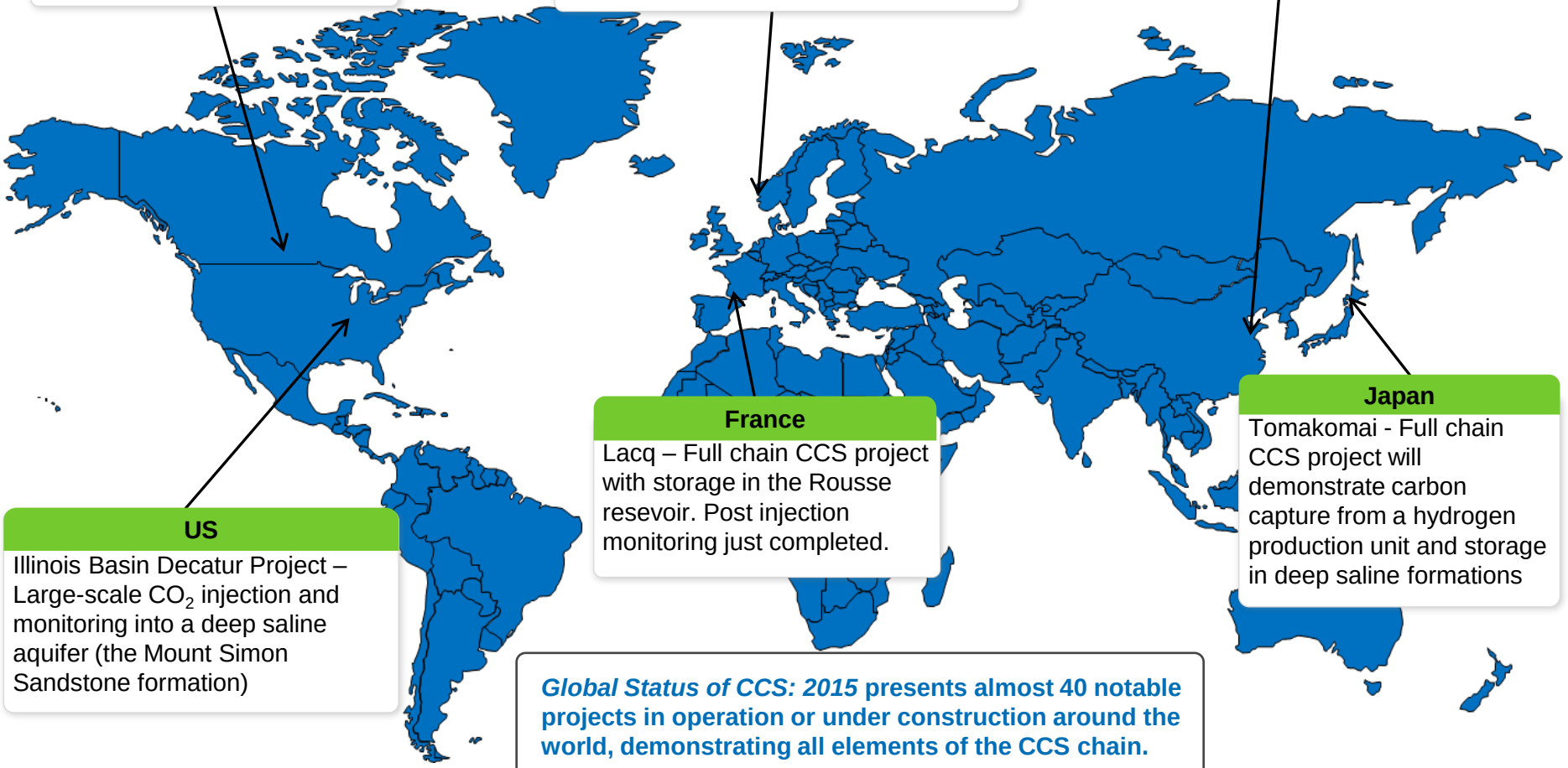
Shand Test Facility (CCTF) – Operational test facility for amine based post-combustion capture technologies

**Norway**

Technology Centre Mongstad – Operational test facility for amine and ammonia based post-combustion capture technologies

**China**

Sinopec Shengli – Operational full chain CCS power sector project utilising EOR storage



**US**

Illinois Basin Decatur Project – Large-scale $CO_2$ injection and monitoring into a deep saline aquifer (the Mount Simon Sandstone formation)

**France**

Lacq – Full chain CCS project with storage in the Rousse resevoir. Post injection monitoring just completed.

**Japan**

Tomakomai - Full chain CCS project will demonstrate carbon capture from a hydrogen production unit and storage in deep saline formations

***Global Status of CCS: 2015*** **presents almost 40 notable projects in operation or under construction around the world, demonstrating all elements of the CCS chain.**

**A selection of these projects are presented in this slide.**

# Summary

# Summary

**Why is CCS important?**

- The majority of the world's emissions comes from fossil fuel facilities

**The contribution of CCS to reduce global emissions**

- IEA estimates CCS will need to contribute 13% of global emission reductions on a least cost basis

**Cost of mitigation increases without CCS**

- The IPCC estimate that the cost of achieving our global emission reductions without CCS will increase by an estimated 138%

**Global Status of CCS – proven at large scale**

- 15 large scale projects already operating.
- 7 under construction
- Many smaller scale projects in operation

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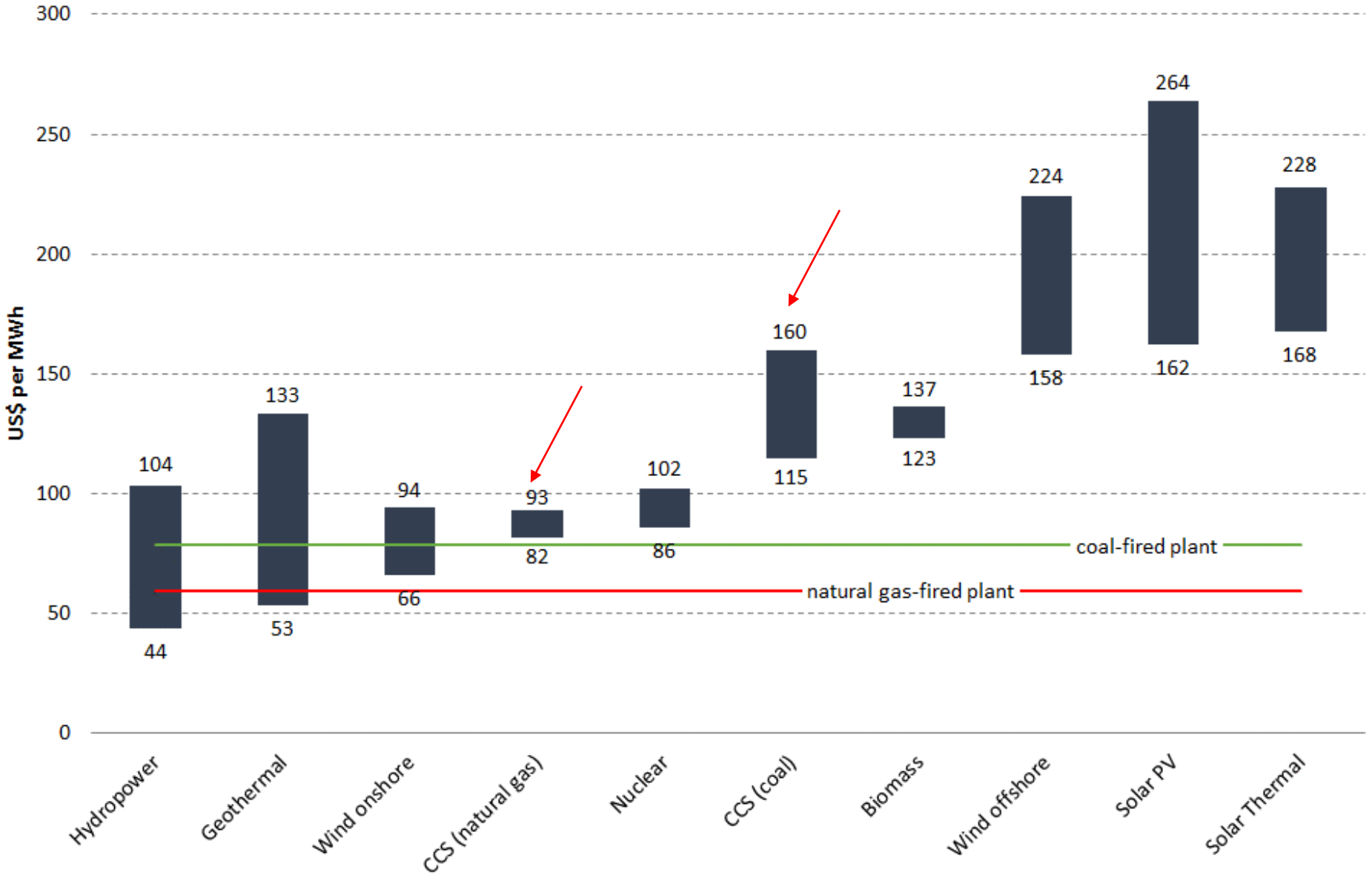
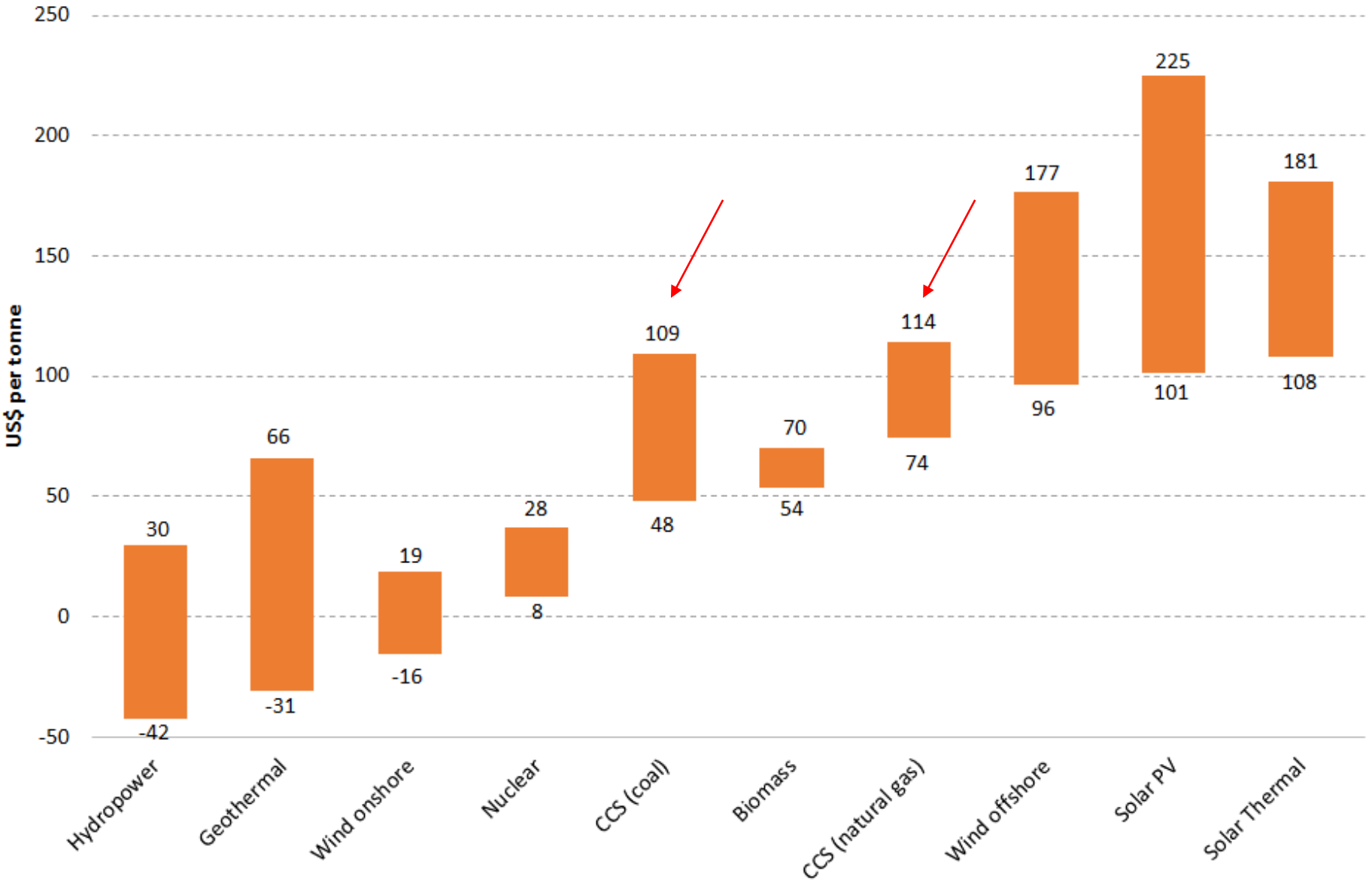
# Appendix Slides

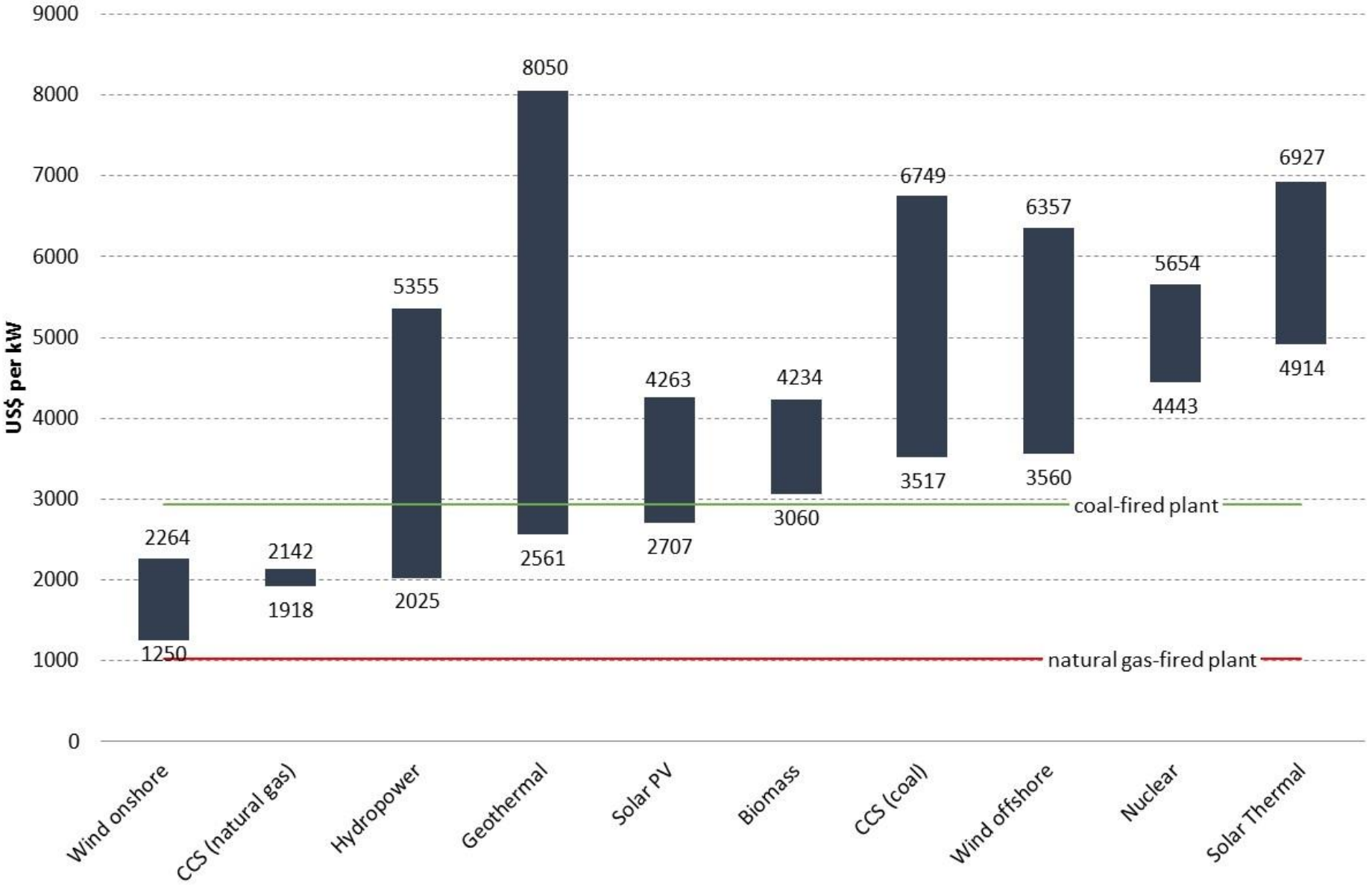
# Power generation levelised costs



# Power generational – costs of CO2 avoided



# POWER GENERATION CAPITAL COSTS



# Business case drivers

## Revenue diversification

**For example:**

- $CO_2$ for enhanced oil recovery
- Urea for fertiliser
- Fly ash for concrete
- Sulphuric acid

## Government Support

**For example:**

- Capital grants
- Operational subsidies
- Carbon credits
- Purchase agreements
- Public-private partnerships
- Rate-payer cost recovery
- Infrastructure provision or support

## Regulatory Requirement

**For example:**

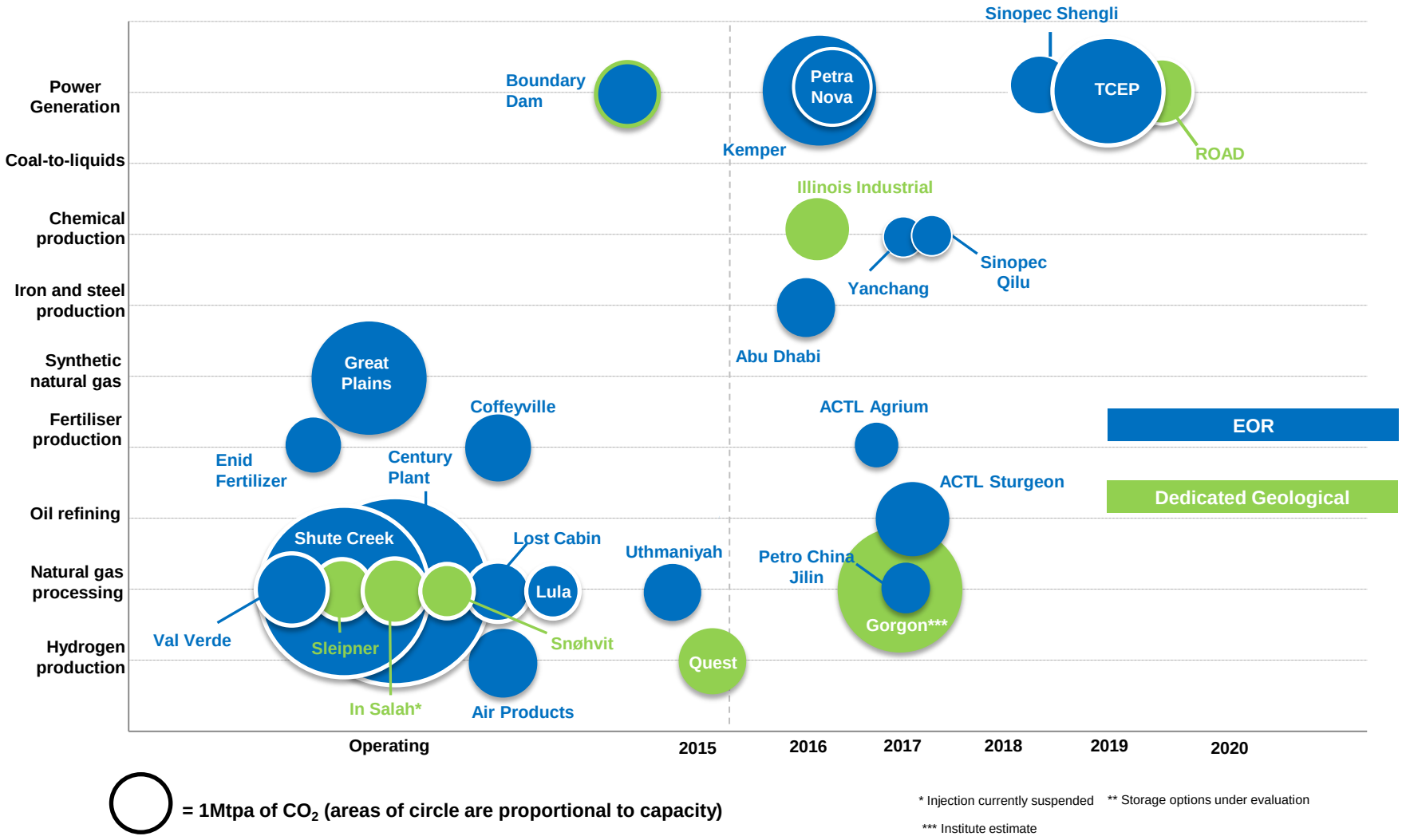
- Carbon tax – e.g. Norwegian projects
- Legislative requirement – e.g. Gorgon project, Australia
- Emission standards – e.g. Boundary Dam, Canada

**The objective of the project impacts the business case**

# Government support examples

| INDUSTRY | PRIMARY STORAGE OPTION | PROJECTS | GOVERNMENT SUPPORT (REGIONAL, NATIONAL, SUBNATIONAL) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Capital grants | Operational subsidies | Carbon credits | Purchase agreements | Public–private Partnerships | Rate payer cost recovery | Loan guarantees | Other tax incentives | Transport infrastructure | Storage infrastructure | Storage liability costs |
| Natural gas processing | Dedicated storage | Gorgon | ✓ | | | | ✓ | | | | | ✓ | ✓ |
| | EOR | Uthmaniyah | | | | | | | | | | ✓ | |
| Chemical production | Dedicated storage | Illinois ICCS | ✓ | | ✓ | | ✓ | | | | ✓ | ✓ | ✓ |
| Fertiliser production | EOR | ACTL–Agrium | ✓ | ✓ | | | | | | | ✓ | ✓ | |
| Hydrogen production (oil refining) | EOR | ACTL–NWSR | ✓ | ✓ | | | | | | ✓ | ✓ | ✓ | |
| | Dedicated storage | Quest | ✓ | | ✓ | | | | | | | | |
| Power generation | EOR | Boundary Dam | ✓ | | ✓ | | ✓ | ✓ | | | ✓ | ✓ | ✓ |
| | | Kemper County | ✓ | | | ✓ | | ✓ | | | | | |

# Actual and expected operation dates for projects in operation, construction and advanced planning




○ = 1Mtpa of $CO_2$ (areas of circle are proportional to capacity)

* Injection currently suspended ** Storage options under evaluation

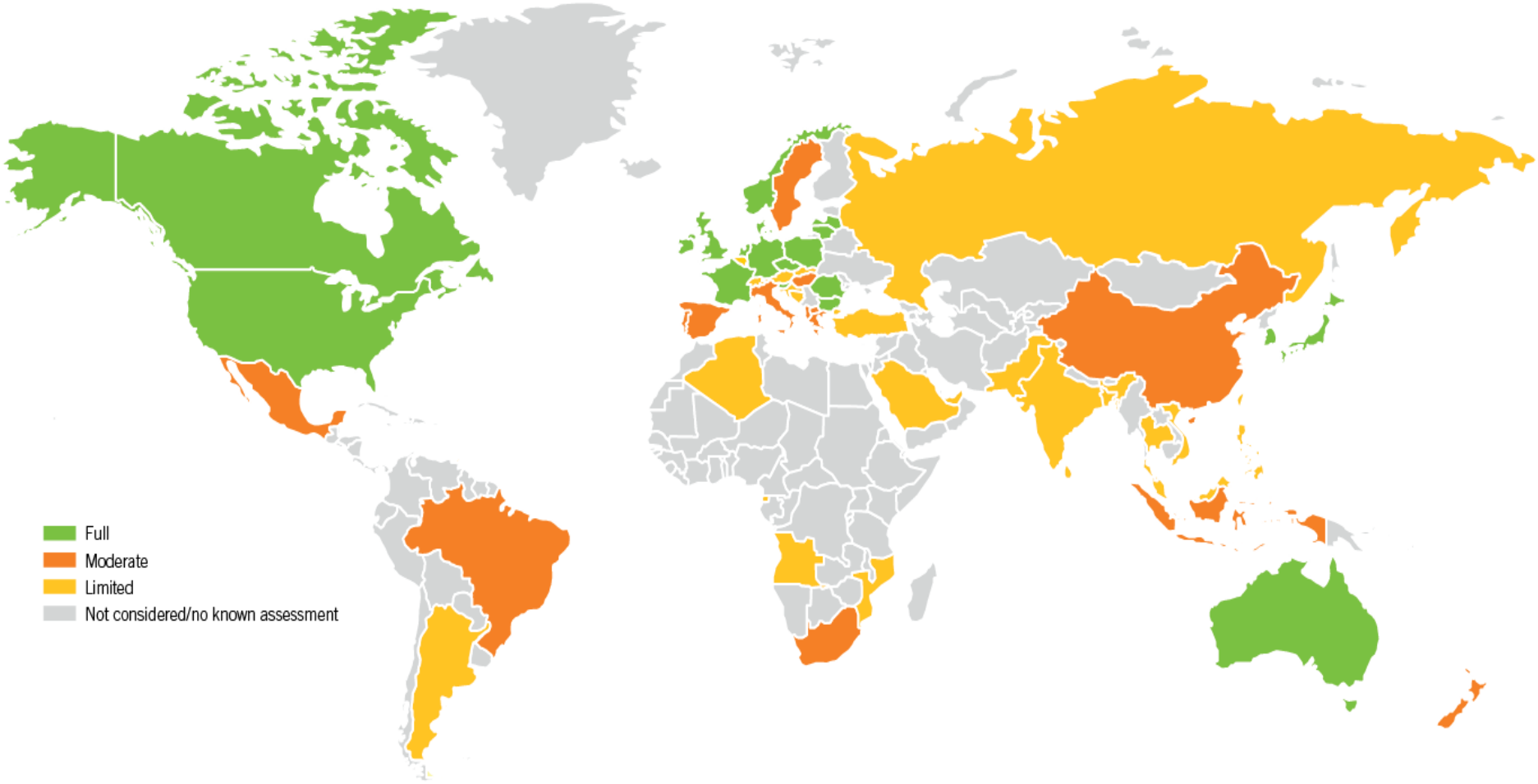
*** Institute estimate

# CCS Legal and Regulatory Indicator results

| COUNTRY | | TOTAL SCORE (out of a possible 87) |
|---|---|---|
| **BAND A:** CCS-specific laws or existing laws that are applicable across most parts of the CCS project cycle (5 countries) | | Average score: 65 |
|  | Australia | 67.0 |
|  | Canada | 65.5 |
|  | United Kingdom | 65.0 |
|  | United States | 64.0 |
|  | Denmark | 62.0 |
| **BAND B:** CCS-specific laws or existing laws that are applicable across parts of the CCS project cycle (27 countries) | | Average score: 47 |
| **BAND C:** Very few CCS-specific or existing laws that are applicable across parts of the CCS project cycle (21 countries scored) | | Average score: 26 |

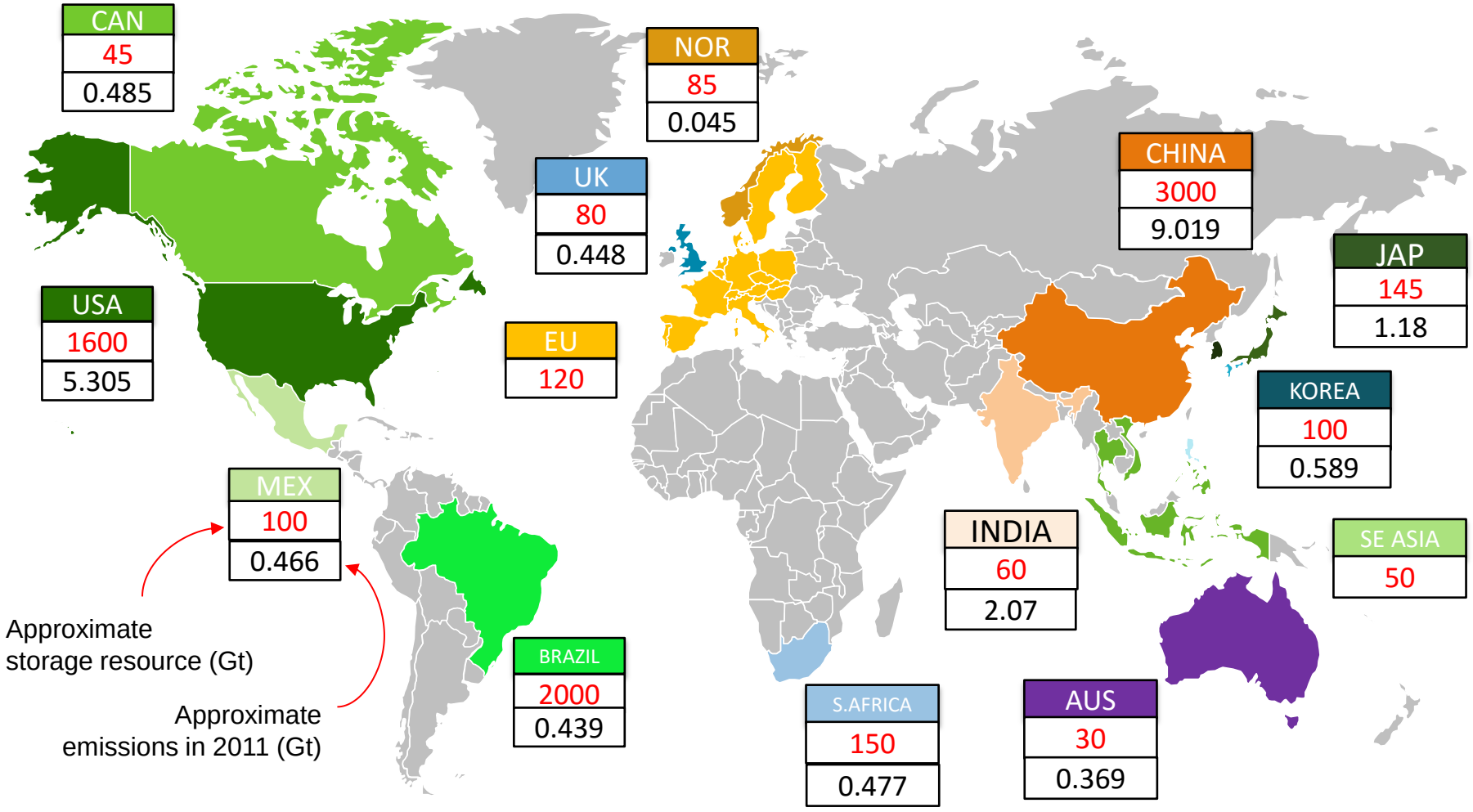
**Source**: *Global CCS Institute CCS Legal and Regulatory Indicator,* Global CCS Institute (2015)

# Geographical coverage of storage resource assessments




**Source**: *Global Storage Readiness Assessment,* Global CCS Institute & Causebrook (2015)

# Is there enough storage space?




Values from various public sources of information, including national to basin-scale studies to assessments of depleted oil and gas fields only. SE Asia only includes Indonesia (South Sumatra), Philippines, Thailand, Viet Nam.

# Energy Penalty Considerations

1. R&D aimed at reducing energy penalty

2. Renewables could potentially be used to generate some additional power requirements

3. New build – can scale up to offset parasitic load
   - Not a significant cost driver